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Tianshui's three treasures: water and soil conservation in wartime northwest China

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ABSTRACT

In addition to examining how wartime imperatives shaped the agricultural research, demonstration, and extension programs undertaken by the Nationalist government's Tianshui Water and Soil Conservation Experiment Area (the Experiment Area) after its founding in 1942, this article assesses the rural populace's responses to these conservation measures. While the Experiment Area's plans to construct terraces and ditches were not well suited to the socioeconomic and environmental conditions that existed in rural Gansu during the 1940s, its introduction of non-native tree and grass species to check water and soil loss met with an enthusiastic response from Tianshui's populace. Water and soil conservation specialists aspired to rationalize human interactions with the environment as part of wartime efforts to develop the northwest, but to realize these goals they had to take socioecological realities in the region and the needs of rural residents into account. Wartime conservation's environmental legacies, the article also shows, extended into the period after 1949.

KEYWORDS

Agriculture; conservation; environment; erosion; Gansu; Tianshui

Introduction

If you hike up the steep and winding path to see the terraces built using earthen embankments (also known as bunding) in the hills above Tianjiazhuang village outside the city of Tianshui in southeast Gansu Province, an informed guide can point out withered stands of black locust trees planted more than half a century ago and now abandoned. At the right time of year, if you look closely enough, your guide can also identify sweet clover plants growing in terraced fields that rise step by step up the hillsides and ravines that surround Tianshui. These elements of landscape – embankments, sweet clover, and locust trees – gained a reputation during the 1950s among proponents of water and soil conservation (*shuitu baochi*) as "Tianshui's three great treasures" (*Tianshui san da bao*) for their efficacy in checking erosion.[1] The uncovering of those "treasures" and the importance they gained in Northwest China, as this article shows, represent an unacknowledged environmental legacy of World War II.

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[1]Dong Xianghua, "Jiefang qianhou Tianshui shuitu baochi keyan shiyan gongzuo," 379; and Gao Jishan, "Zhongguo shuitu baochi shihua (caogao)," 64.

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The War of Resistance (the Sino-Japanese War of 1937–1945) did tremendous damage to China's environment, the full extent of which historians have not yet fathomed.[2] More counterintuitively, the war also catalyzed a range of conservation efforts undertaken by China's Nationalist government. These initiatives included the birth of China's earliest water and soil conservation programs based on globally circulating scientific principles. As in many other realms, World War II marked a turning point in China's environmental history. Beginning in the 1920s, Chinese agriculture, forestry, and water conservancy experts fervently promoted globalized visions of soil erosion's causes and consequences drawn primarily from the United States.[3] But it was not until the 1940s that, influenced by American advisers to China, the Nationalist central government in Chongqing moved to implement its first comprehensive water and soil conservation programs in Northwest China's Loess Plateau (Huangtu gaoyuan), a region that covers 640,000 square kilometers and suffers from high rates of erosion and acute water shortages.

By examining the history of conservation efforts undertaken in Northwest China during the 1940s, this article supports the hypothesis that World War II "had global repercussions for environmental ideas and activities." World War II "synchronized global activities and generated surprisingly similar and simultaneous emergence and development of new environmental perceptions, organizations, and activities in the postwar world." World War II's role as a "stimulus for nature conservation movements on different continents," as Simo Laakkonen, Richard Tucker, and Timo Vuorisalo have suggested, made the conflict "a major turning point in environmental policy making over the twentieth century."[4]

But even if water and soil conservation in China during the 1940s paralleled the global emergence of environmental approaches and ideas, it grew out of developments specific to China's wartime experience. For Chinese water and soil conservation specialists during the war years, the interlocking objectives of harnessing scarce resources to resist the Japanese invasion, developing the environments of China's northwest frontier, and strengthening the nation-state required checking water and soil loss by rationalizing land use. Water and soil conservation plans assumed enormous importance after the Japanese occupation of China's main economic centers made it imperative for the Nationalist regime to efficiently manage and develop the land and resources of the western interior to support wartime economic mobilization.[5] Foremost among the initiatives taken in pursuit of these goals was the establishment of the Tianshui Water and Soil Conservation Experiment Area (Tianshui shuitu baochi shiyanqu, the Experiment Area) in August 1942 by the Nationalist regime's Ministry of Agriculture and Forestry (Nonglinbu).[6] Today, this research organ continues to operate at the same site where it was founded (Figure 1) as the Yellow River Water and Soil Conservation Tianshui Management and Supervision Bureau/Tianshui Water and Soil Conservation Scientific Experiment Station (Huanghe shuitu baochi Tianshui zhili jiandu ju/Tianshui shuitu baochi kexue shiyanzhan).

In addition to examining how the imperatives of wartime mobilization informed the Tianshui Water and Soil Conservation Experiment Area's earliest research,

[2]Muscolino, *The Ecology of War in China*.
[3]Muscolino, "Woodlands, Warlords, and Wasteful Nations."
[4]Laakkonen, Tucker, and Vuorisalo, "Hypotheses: World War II and Its Shadows," 323.
[5]Muscolino, "Refugees, Land Reclamation, and Militarized Landscapes in Wartime China."
[6]Dong Xianghua, "Jiefang qian de Tianshui shuitu baochi gongzuo"; Dong Xianghua "Jiefang qianhou Tianshui shuitu baochi keyan shiyan gongzuo"; Yang Hongwei, "1940 niandai de Tianshui shuitu baochi shiyanqu shulun"; and Mo Shiao, "Zhongguo shuitu baochi de faxiangdi – Tianshui."

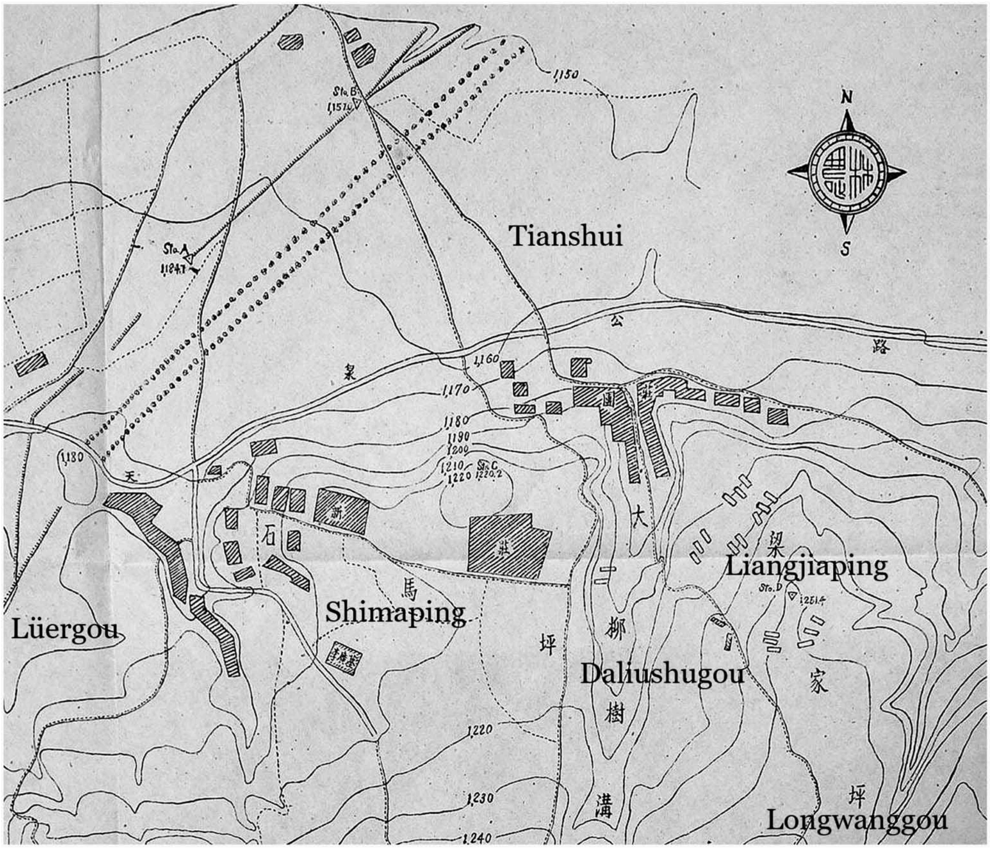

Figure 1. Tianjiazhuang is located to the southwest of the area depicted in this map. Liguanwan is located to the southeast.

Source: Nonglinbu shuitu baochi shiyanqu Tianshui Nanshan shiyanchang dixingtu [Topographical Map of Ministry of Agriculture and Forestry Water and Soil Conservation Experiment Area Tianshui Nanshan Experiment Station], Tianshui shuitu baochi shiyanqu dang'an [Tianshui Water and Soil Conservation Experiment Area Archives], file no. 20-59-013-03.

demonstration, and extension programs, this article assesses the socioeconomic and ecological factors that shaped the rural populace's responses to these measures. The overall picture is ambivalent. During the War of Resistance and its immediate aftermath, the Experiment Area's demonstration projects encountered a divergence between state-initiated demonstration and extension schemes and the priority that rural residents placed on sustaining agricultural production to ensure their own subsistence. The priorities of the expert and the farmer did not always coincide. While the Experiment Area's plans to construct elaborate systems of terraces and ditches to limit water and soil loss were not well adapted to the socioeconomic and environmental constraints that prevailed in rural Gansu during the 1940s, the promotion of soil and water conservation through the introduction of non-native tree and grass species met with an enthusiastic response from the local populace. Although conservation specialists in Tianshui aspired to rationalize human interactions with the land as part of a larger wartime effort to develop Northwest China, the success or failure of measures depended on the extent to which they fit with the socioecological conditions in the region and spoke to the quotidian needs of its rural residents.

Trouble with terraces

Water and soil conservation specialist Ren Chengtong, who worked for the Tianshui Water and Soil Conservation Experiment Area as a technical consultant appointed by the central government in Chongqing, clearly articulated the connection between conservation efforts and the larger goal of "reconstructing the northwest" (*jianshe Xibei*). Writing in 1943, Ren held that China's northwest was "the cradle of the Chinese race" (*huaxia minzu de faxiangdi*). Ancient ruins revealed the past existence of "wealthy and flourishing capitals and ancient towns" in areas that had since been encompassed by the Gobi Desert. Desiccation and decline, according to Ren, "resulted from people of that time coveting immediate profits and excessively cultivating steep mountain slopes." Not only did farmers all over China still cultivate inclined lands, but officials who advocated frontier development and land reclamation mistakenly promoted it as well. "If this error is not actively corrected and continues to spread," Ren warned, "then today's bustling cities will in the future turn into ancient cities beneath the desert." In his view, the purpose of conservation was simple: "It is only, based on various methods for exhausting the land's benefits [*di jin qi li zhi fangfa*], applying principles for sustaining the land's perpetual productive capacity [*baochi tudi yongjiu shengchan nengli zhi yuanze*]." The Nationalist regime had to reconstruct the northwest and open the frontier (*kaifa bianjiang*), but it also had to "use water and soil conservation as the central principle in carrying out this work."[7]

Writing in 1945, the Experiment Area's director, Ye Peizhong, explicitly stated that wartime circumstances made conservation a priority: "During the War of Resistance, reconstructing the northwest has been looked upon as important, and carrying out water and soil conservation to increase agricultural production has become an even more important program."[8] Other conservation experts employed military-strategic language to capture the significance of combatting water and soil loss. Wei Zhanggen, a technician at the Experiment Area, cast land degradation caused by soil erosion in the following terms: "If water and soil conservation and the work of maintaining land's productive capacity are not promptly carried out, then cultivated land will be eroded into gullies, good fields will turn into deserts, and it will truly be lost soil (*shitu*) that our nation will have no way to recover." Erosion resulted in loss of national territory in a manner analogous to foreign

[7]Ren Chengtong, "Jianshe Xibei yu shuitu baochi," 470. In late 1940, Ren Chengtong set up China's first water and soil conservation research organ, the Longnan Water and Soil Conservation Experiment Area (Longnan shuitu baochi shiyanqu), which was also based in Tianshui, on behalf of the central government's Yellow River Conservancy Commission (Huanghe shuili weiyuanhui), but it soon folded due to lack of funds and bureaucratic in-fighting. After 1943, Ren worked as an advisor to the Tianshui Water and Soil Conservation Experiment Area. Zhongguo kexue jishu xiehui, *Zhongguo kexue jishu zhuanjia zhuanlue*, 156–167. On Ren Chengtong's earlier career see Muscolino, "Woodlands, Warlords, and Wasteful Nations."

[8]Ye Peizhong, "Xu," in Nonglinbu shuitu baochi shiyanqu, *San nian lai zhi Tianshui shuitu baochi shiyanqu* (1946), a book found in Tianshui shuitu baochi shiyanqu dang'an, file no. 20-59-013-03.

invasion and had to be opposed with equal vigor.[9] By rationalizing land use, conservation would defend against these losses.[10]

What programs could realize that objective in substantive terms? Along with afforestation, expansion of pastures, and refined cultivation techniques, Wei Zhanggen pointed to the Experiment Area's efforts to improve the land (*gaijin tudi*) by constructing terraces and ditches (*titian gouxu*) to prevent water and soil loss (Figures 2 and 3). Without denying that Chinese farmers already had centuries of experience building terraces, Wei argued that they covered only a limited area and that scientific research was needed to improve existing techniques. For this reason, the Experiment Area's "terrace and ditch demonstration projects" implemented effective types and designs and promoted their construction.[11]

By conserving water, terraces and ditches would benefit agriculture by maintaining the land's productive capacity and increasing the soil's moisture content, which averted drought and increased production. They would also decrease the volume of floodwaters and lower their sediment content, thereby averting flood-related disasters.[12] In China's northwest, Wei Zhanggen wrote, the climate was dry and cold, and precipitation was inadequate. Rain fell mostly during the growing season, so there was no way to utilize rainwater for crops, and runoff also carried away large amounts of fertile topsoil. Yet the permeability of the region's loess soils was good enough that terraces and ditches built on inclined fields could intercept runoff and "conserve" (*baoxu*) water and soil. On steeply inclined land with poor surface soils and permeability, terraces and ditches would also improve drainage.[13]

The Experiment Area initiated its terrace and ditch demonstration projects in May 1943, when it built 386.4 *zhang* (about 1,288 meters) of terraces on the banks of

Figure 2. Terrace and Ditch construction at Liangjiaping.

Source: Nonglinbu shuitu baochi shiyanqu [Ministry of Agricultural and Forestry Water and Soil Conservation Experiment Area], *San nian lai zhi Tianshui shuitu baochi shiyanqu* [Tianshui Water and Soil Conservation Experiment Area over the Past Three Years] .

[9]Wei Zhanggen, "Titian gouxu zhi sheji yu shishi," 59. My research has unfortunately not uncovered any biographical information on Wei Zhanggen.
[10]Wei Zhanggen, "Titian gouxu zhi sheji yu shishi," 59.
[11]Ibid.
[12]Ibid., 60.
[13]Ibid., 64.

Figure 3. Digging broad-based ditches.

Source: Nonglinbu shuitu baochi shiyanqu [Ministry of Agricultural and Forestry Water and Soil Conservation Experiment Area], *San nian lai zhi Tianshui shuitu baochi shiyanqu* [Tianshui Water and Soil Conservation Experiment Area over the Past Three Years].

a gully south of Tianshui called Lüergou. Later that year, a delegation led by Assistant Chief of the United States Soil Conservation Service, Walter C. Lowdermilk, who taught Ren Chengtong and other Experiment Area personnel at the University of Nanking in the 1920s, visited Tianshui and designated 3,328 *mu* (221.9 hectares) of land at Liangjiaping as the main demonstration site.[14] After completing topographical and soil surveys – and resolving a dispute with local landowners – in spring 1944 the Experiment Area began constructing bench terraces and broad-base terraces in several small watersheds. But tension between agricultural production and water and soil conservation measures hampered the terrace and ditch demonstration projects. As a later report explained, "To give consideration to farmers' cultivation activities, work had to be done when agricultural land lay fallow, so it proceeded slowly, with only 181.1 *zhang* (603.6 meters) of terraces and ditches completed."[15]

But with the Nationalist government's backing, the terrace and ditch project gradually made headway. As one of the Experiment Area's technical experts Yan Wenguang recalled, "In organizing work, in addition to a small area in which the county

[14]On Lowdermilk's research in China during the 1920s see Muscolino, "Woodlands, Warlords, and Wasteful Nations."

[15]"San nian lai zhi Tianshui shuitu baochi shiyanqu," 3. See also Wei Zhanggen, "Titian gouxu zhi sheji yu shishi," 72; Mo Shiao, "Huanghe shuili weiyuanhui Tianshui shuitubaochi kexue shiyanzhan zhanzhi," 124; Tianshui shi difangzhi bianweihui, *Tianshui shizhi*, 1111–1112, and 1115; Tianshui shi kexue jishu zhi bianjibu, *Tianshui shi keji jishu zhi*, 611–612.

government enlisted civilian laborers from nearby townships to engage in construction, over a large area state investment was utilized to hire workers." By late 1945, the Experiment Area constructed 16,500 meters of bench terraces and built small-scale embankments along roads to guide water into ditches and prevent it from causing erosion. These measures covered more than 2,000 *mu* (133.3 hectares) of land, which accounted for 80 percent of the Experiment Area's territory.[16]

Convincing farmers to adopt conservation techniques on a larger scale, however, was not a simple task. In Tianshui, cultivation extended to steep slopes with gradients of over 30 percent, where severe erosion stripped away surface soils. Thus, "paying attention to farmers' need to cultivate," narrow drainage channels were added to terraces and ditches to decrease runoff and check erosion. Yet, as Wei Zhanggen admitted, experimental results showed that not only were drainage channels expensive, "they also yielded few results." How to manage steep slopes effectively and whether making farmers change to planting pasture grass or animal husbandry would suffice to support their livelihoods awaited further research. Clearly, socioeconomic conditions had a bearing on the feasibility of conservation projects. As Wei wrote, "In light of most farmers' economic capacity, although they know that carrying out terrace and ditch engineering projects could indeed improve the land's use value, they still do not have the power to construct them on their own and require government assistance."[17]

Yan Wenguang's retrospective assessment went further in explaining the initial ambivalence of Tianshui's rural populace towards terraces and gullies. Farmers' attitudes towards implementing conservation measures on their land were "not welcoming and also not rejecting." Most thought that "management measures made sense in principle and admitted that they were a good thing." But the influence of conservation projects on agricultural production was not always positive. Because some terraces and level ditches were not of high quality, after they were built "virgin soil [*shengtu*] was exposed and it had a negative influence on crop growth, which led to decreased production in some places, and for this reason it aroused farmers' suspicions, or they felt that digging a level ditch on a piece of land impeded cultivation, so after they were constructed some people intentionally or unintentionally destroyed the engineering projects."[18] Local ambivalence towards conservation projects, in these cases, broadened into outright opposition.

Yan Wenguang admitted that after the first few years, despite some achievements, conservation measures implemented in Tianshui encountered "quite a few problems worth paying attention to."[19] For instance, although level ditches on slopes were supposed to "impede runoff and sediment" so that moisture would gradually permeate

[16]Yan Wenguang, "Minguo shiqi shuitu baochi zhi zui," 73. See also Wei Zhanggen, "Titian gouxu zhi sheji yu shishi," 72; Mo Shiao, "Huanghe shuili weiyuanhui Tianshui shuitu baochi kexue shiyanzhan zhanzhi," 124; Tianshui shi difangzhi bianweihui, *Tianshui shizhi*, 1112, and 1115; and Tianshui shi keji jishu zhi bianjibu, *Tianshui shi keji jishu zhi*, 611–612. Born in Xi'an in 1920, Yan Wenguang found employment as a technician at the Tianshui Water and Soil Conservation Experiment Area in 1944 after he graduated from the water conservancy section at National Northwest Technical School (Guoli Xibei jishu zhuanke xuexiao). Yan went on working at the Tianshui Water and Soil Conservation Experiment Area for forty years and served as its director for a time. Xiang Hua, "Gansu shuitu baochi gongzuo de jiwei kaichuangzhe," 167–168; and Mo Shiao, "Huanghe shuili weiyuanhui Tianshui shuitu baochi kexue shiyanzhan zhanzhi," 220.

[17]Wei Zhanggen, "Titian gouxu zhi sheji yu shishi," 73.

[18]Yan Wenguang, "Minguo shiqi shuitu baochi zhi zui," 73.

[19]Ibid.

soil and benefit crop production, seedlings on terraced fields could easily be flooded or "killed by the sediment" (*yu si*). As Yan explained, "Especially when carrying out construction of terraces and level ditches, not paying attention to the handling of surface soil and digging up bottom soil and pressing down surface soil, thereby making the soil become poor, led to decreased production." All these factors combined to make Tianshui's farmers anxious (*huailü*) about terraces.[20]

The prevailing system of land tenure also limited the effectiveness of water and soil conservation efforts. Decades of soil erosion on Northwest China's Loess Plateau had made cultivated areas narrow and fragmented. As Wei Zhanggen explained, "If, after terrace and ditch engineering projects along the contour line are planned, land becomes even more fragmented and it impedes cultivation, it will be difficult to make farmers willingly accept them." Because tracts of land on which terraces were built often belonged to multiple households, it was hard to convince farmers to cooperate in carrying out these projects. Implementing conservation measures, in Wei's view, thus required redemarcating (*chonghua*) landholdings. If redemarcation gave farmers on upper and lower slopes larger holdings, "cultivation will not be difficult, and land can be rationally utilized." For that reason, field engineering projects needed to be accompanied by clarification of landholdings and productivity assessments.[21] Furthermore, because most farmland on the outskirts of Tianshui belonged to urban landlords, Yan Wenguang observed, "it was impossible to mobilize farmers' enthusiasm for working the land to construct bench terraces."[22] Confronted with socioecological conditions that existed in Tianshui during the mid-1940s, remaking the landscape into a system of terraces and ditches – and in the process reengineering relations among people and their connections to the land – was not nearly as easy as Chinese conservation experts envisioned.

During the post-war period, the Experiment Area's personnel came up with ways to get around these challenges. As a 1948 report stated, the one-meter-wide grass strips (*caodai*) planted along the edges of terraces on slopes with gradients of over 15 percent to conserve soil did not grow well, and the grass was not dense enough to retain sediment.[23] "Therefore," this report noted, "fertile soil from fields still pours into ditches in large amounts, making surface soil gradually become infertile, while also increasing the onerousness and difficulty of ditch repair work." At the same time, the local populace resisted the addition of grass strips due to their effects on agricultural production. Most farmers disliked the fact that the grass strips "occupied too much

[20]Ibid., 74.

[21]Wei Zhanggen, "Titian gouxu zhi sheji yu shishi," 73–74. See also Yan Wenguang, "Minguo shiqi shuitu baochi zhi zui," 74.

[22]Yan Wenguang, "Minguo shiqi shuitu baochi zhi zui," 74. On difficulties that landlord-tenant relations created for conservation work, see also Nonglinbu shuitu baochi shiyanqu sanshiliu niandu shangbannian gongzuo jindu jiantao baogao biao [Ministry of Agriculture and Forestry Water and Soil Conservation Experiment Area Work Progress Examination Report Table for the First Half of 1947] (July 1947), Nonglinbu Tianshui shuitu baochi shiyanqu dang'an, file no. 27-2-39.

[23]The report indicated that planting grass strips on the edge of terraces exposed a wider area to sunlight and air, which caused moisture to evaporate easily and dried the soil. For that reason, grass did not grow well. Nonglinbu shuitu baochi shiyanqu sanshiqi niandu shangbannian gongzuo jindu jiantao baogao biao [Ministry of Agriculture and Forestry Water and Soil Conservation Experiment Area Work Progress Examination Report Table for the First Half of 1948] (July 1948), Nonglinbu Tianshui shuitu baochi shiyanqu dang'an, file no. 27-2-46. The same report appears in Nonglinbu shuitu baochi shiyanqu sanshiqi niandu zhengji bijiao biao [Ministry of Agriculture and Forestry Water and Soil Conservation Experiment Area 1948 Achievement Comparison Table] (January 1949), Nonglinbu Tianshui shuitu baochi shiyanqu dang'an, file no. 27-2-49. See also Mo Shiao, "Huanghe shuili weiyuanhui Tianshui shuitu baochi kexue shiyanzhan zhanzhi," 24.

land, they did not willingly accept them, and when tilling they often destroyed them, so it is difficult to attain results in protection."[24]

As a solution, Wei Zhanggen and Yan Wenguang recommended replacing grass strips with low earthen embankments known as bunding (*dibian geng*) next to the ditches along the edge of terraced fields, which would occupy less land and be more useful in intercepting silt. This measure proved easy to carry out and gained ready acceptance among the rural populace.[25] After the Chinese Communist Party's assumption of power in 1949, Wei, Yan, and the Tianshui Water and Soil Conservation Area's other expert personnel continued to advocate these conservation techniques. During the first decade of the People's Republic of China, inclined terraces built using earthen embankments devised at Tianshui became a primary component of water and soil conservation programs in Gansu. By 1956, approximately 3,562,200 *mu* (237,480 hectares) of embankments had been constructed in the Tianshui Administrative Region.[26]

Treasure grass

In contrast to terraces and ditches, which met with early difficulties, experiments raising plants that could promote water and soil conservation yielded rapid results. In 1944, under the direction of Ye Peizhong, a plant breeding specialist by training, the Experiment Area established a pasturage station (*mucao yuanzhongchang*) that gathered over five hundred types of grasses from various parts of China, as well as varieties from foreign countries, to identify potentially useful varieties for preserving water and soil.[27]

Ye Peizhong, a native of Jiangsu's Jiangyin County, graduated in 1927 from the Forestry Department at the University of Nanking, where he studied with Lowdermilk. Ye oversaw the Liucheng Forestry Station (Liucheng linchang) affiliated with the Liuzhou Reclamation Bureau (Liuzhou kenhuangju) in Guangxi until 1929, when military disturbances led to its closure. That year, Ye returned to Nanjing to assist in designing a botanical garden for the Sun Yat-sen Mausoleum (Zongli lingyuan). To prepare for this task, Ye traveled to the Royal Botanical Garden in Edinburgh in 1930 to study garden design and plant breeding. Upon returning to China with his master's degree in 1931, Ye served as the Sun Yat-sen Mausoleum Botanical Garden's first director, but the garden's operations ceased in 1937 with the Japanese occupation of Nanjing. After the outbreak of the War of Resistance, Ye taught briefly at an agricultural school in Hunan before moving to Sichuan as the director of the province's Emeishan Forestry Experiment Station (Emeishan Linye shiyanchang), and from 1941 to 1943 he served as a researcher at the Nationalist government's Chongqing Tung Oil Research Institute (Chongqing tongyou yanjiusuo). Ye later joined the Northwest Investigation Group (Xibei kaochatuan) led by Lowdermilk, which surveyed water and soil conservation conditions in Shaanxi, Gansu, and Qinghai on behalf of the

[24]Nonglinbu shuitu baochi shiyanqu sanshiqi niandu shangbannian gongzuo jindu jiantao baogao biao (July 1948), Nonglinbu Tianshui shuitu baochi shiyanqu dang'an, file no. 27-2-46; Nonglinbu shuitu baochi shiyanqu sanshiqi niandu zhengji bijiao biao (January 1949), Nonglinbu Tianshui shuitu baochi shiyanqu dang'an, file no. 27-2-49.

[25]Mo Shiao, "Huanghe shuili weiyuanhui Tianshui shuitubaochi kexue shiyanzhan zhanzhi, 124–125.

[26]Tianshui shi difangzhi bianzuan weiyuanhui, *Tianshui shizhi*, 1115; and Mo Shiao, "Huanghe shuili weiyuanhui Tianshui shuitu baochi kexue shiyanzhan zhanzhi," 124–125.

[27]The pasturage station's activities are described in Li Ronghua, "Minguo Tianshui shuitu baochi shiyanqu mucao pinzhong de xuanyu."

Nationalist regime's Ministry of Agriculture. Once the investigation concluded in 1943, Ye remained in Gansu to lend his expertise to the Tianshui Water and Soil Conservation Experiment Area, and in 1945 he became its director.[28]

Given his training and experience, Ye Peizhong devoted most of his attention to the Experiment Area's selection and breeding of soil-conserving plant varieties. Sweet clover (*caomuxi*), a nitrogen-fixing leguminous species native to Eurasia and introduced in North America and elsewhere as a forage crop, proved one of the most successful of these plants. Wild varieties of sweet clover grew throughout China during the 1940s, and Ye did not ignore them. In the years 1942–1943, Ye had gathered over two thousand plant samples, including several types of sweet clover, while participating in Lowdermilk's investigative tour of Northwest China.[29] A report from 1945 described the Experiment Area's success in "discovering effective soil conservation plants" by collecting pasturage grass and tree species in Shaanxi, Gansu, and Qinghai. Some of this flora came from nearby Tianshui. As the report explained, "In this locale we discovered a kind of *Melilotus alba* [*sic*] that is similar to American sweet clover. It was experimentally planted on infertile soil and 160 liters of seeds and 800 kilograms of dry grass were harvested from every *mu*. Fresh grass can serve as fodder. If dried grass is used as kindling, with each 500 grams calculated as 3 *yuan*, it can be sold for 4,800 *yuan*. This can solve the northwest's fuel and fodder problems."[30]

But the types of sweet clover cultivated in the Experiment Area's wartime extension efforts mainly consisted of introduced rather than locally available varieties. This plant adoption initiative was not without precedent. In the 1930s, the Yellow River Conservancy Commission, the Northwest Agricultural Institute (Xibei nongxueyuan), and other research organs introduced varieties of sweet clover from Germany, but experimental planting did not have much lasting influence. It was not until after 1943, when Ye Peizhong oversaw the Experiment Area's experimental planting of biennial white sweet clover (*baihua caomuxi, Melilotus albus*) and biennial yellow sweet clover (*huanghua caomuxi, Melilotus officinalis*), varieties acquired from the United States Department of Agricultural and Soil Conservation Service, that sweet clover cultivation attracted sustained attention in agricultural extension programs. However, these sweet clover varieties were not native to North America either. Biennial white sweet clover originated in Siberia; biennial yellow sweet clover was a variety that originated in Spain.[31]

Regardless of their origin, the nitrogen-fixing capacity of these sweet clover varieties made them a valuable soil enhancer. Beginning in 1945, the Experiment Area added sweet clover to crop rotation experiments conducted in its runoff plots. When sown as a cover crop on summer fallow land, tests indicated that sweet clover could decrease runoff by 59–68 percent compared to other rotation systems and reduce erosion by 67 percent. In experiments conducted to compare various green manure crops in 1948, sweet clover proved more effective than black beans or adzuki beans. After

[28]Zhongguo kexue jishu xiehui, *Zhongguo kexue jishu zhuanjia zhuanlue*, 199–214.
[29]Mo Shiao, "Caomuxi shihua," 102.
[30]Cheng Xingzhengyuan [Report to the Executive Yuan] (Jan. 9, 1945), Tianshui shuitu baochi shiyanqu dang'an, file no. 20-59-011-08.
[31]Quanguo mucao pinzhong shending weiyuanhui, *Zhongguo mucao dengji pinzhong ji*, 151. See also Mo Shiao, "Woguo caomuxi de yinzhong tuiguang jingguo," 67; and "San nian lai zhi Tianshui shuitu baochi shiyanqu," 8.

62.5 kilograms of beancake fertilizer was applied to each *mu* of land, wheat production reached 79 kilograms per *mu*. But after sweet clover was used as a cover crop, wheat output was 26 percent higher at 94.5 kilograms per *mu*.[32] Besides improving soil quality and boosting crop production when intercropped in fields, the plant also provided feed for livestock and a nectar source for honey bees. Sweet clover's fast and robust growth gave it additional appeal. Its plants grew tall; it adapted well to inclined landscapes, clay soils, and saline-alkaline river banks; and it flourished in upland areas – such as the hills around Tianshui – with elevations over 2,500 meters. Sweet clover's dense branches, leaves, and root structures also checked the loss of water and soil.[33]

But to a large extent, the rapid diffusion of sweet clover during the 1940s derived from its ability to ameliorate the critical fuel shortage that existed in Tianshui and the rest of Northwest China. These shortages had grown even more acute due to demographic changes experienced during the war years, when refugees fled in the hundreds of thousands from occupied territories to China's interior. As Ren Chengtong wrote in 1941, "In Tianshui County, since the beginning of the War of Resistance many refugees from outside provinces have come, so a fuel famine [*chaihuang*] has occurred." Fuel shortages led to unrestrained cutting and charcoal burning, which depleted woodlands as far as 100 *li* (50 kilometers) from Tianshui's county seat. The distance over which timber had to be imported increased 5 *li* (2.5 kilometers) per year, so residents in some areas spent more on fuel than food. Since fuel shortages led to destruction of vegetation cover, the problem had to be solved for conservation measures to yield results.[34] Sweet clover gained popularity because it addressed this need. As Yan Wenguang recalled, white sweet clover supplied a much-needed fuel source in biomass-starved Gansu: "Since their stalks were tall and large and had many branches, a lot of kindling could be collected from them and they burned vigorously, which was a good method for relieving the fuel difficulties of the masses, so without being promoted it spread on its own."[35]

Yan's claim notwithstanding, the spread of sweet clover was not totally spontaneous. Agricultural extension and demonstration also made a difference. In 1946 the Tianshui Water and Soil Conservation Experiment Area took part in a local Farmer's Day Festival (*Nongminjie dahui*) and exhibited one hundred "outstanding soil conservation plant samples," and 50 kinds of seeds, along with photographs and charts.[36] The Experiment Area also planted sweet clover in grass strips along terraces and ditches, which many farmers initially disliked. In the words of a 1947 report, "to promote farmers taking an interest in planting grass strips," after sweet clover matured, the Experiment Area let them harvest it. After threshing, farmers had to give sweet clover seeds to the Experiment Area for cultivation, but they could keep the stalks for their

[32] Mo Shiao, "Caomuxi shihua," 102; Tianshui shi kexue jishu zhi bianjibu, *Tianshui shi kexue jishu zhi*, 609.
[33] Yan Wenguang, "Minguo shiqi shuitu baochi zhi zui," 72–73. See also Mo Shiao, "Caomuxi shihua," 102; and Dong Xianghua, "Jiefang qian de Tianshui shuitu baochi gongzuo," 119–120.
[34] Ren Chengtong, "Gansu shuitu baochi shiyanqu zhi kancha," 7.
[35] Yan Wenguang, "Minguo shiqi shuitu baochi zhi zui," 72–73. See also Mo Shiao, "Caomuxi shihua," 102; and Dong Xianghua, "Jiefang qian de Tianshui shuitu baochi gongzuo," 119–120.
[36] Nonglinbu shuitu, baochi shiyanqu sanshiwu niandu zhengji bijiao biao [Ministry of Agriculture and Forestry Water and Soil Conservation Experiment Area 1946 Achievement Comparison Table] (January 1947), Nonglinbu Tianshui shuitu baochi shiyanqu dang'an, file no. 27-2-63.

Table 1. Sweet clover seeds distributed and cultivated in 1947.

Name	Yang Shirong	Ma Zhanbiao	Mi Jihou	Mu Dezi	Fa Fanglin	Total
Amount [of seeds distributed]	4.0 *shidou* [1 shidou = 10 liters]	5.0 *shidou*	0.3 *shidou*	0.3 *shidou*	1.0 *shidou*	10.6 *shidou*
Cultivation site	Liguanwan	Liguanwan	Liguanwan	Liguanwan	Liguanwan	
Area cultivated	40 *mu*	50 *mu*	3 *mu*	3 *mu*	10 *mu*	106 *mu*

own use. By the end of July 1947, farmers near Tianshui had already handed over approximately 50 kilograms of sweet clover seeds via this arrangement.[37]

It did not take long for sweet clover to gain popularity. When propagated on riverbank land at the mouth of Lüergou, sweet clover caught the attention of nearby residents, who started coming to the Experiment Area to ask for seeds.[38] According to a report from July 1947, farmers from Liguanwan village saw that "the sweet clover planted in this [Experiment] Area can prevent erosion on wasteland and can gradually restore its reproductive capacity [*shengzhi nengli*]. Moreover, its benefits [*shouyi*] are even greater than agricultural crops, so they come one after another to this area to request this kind of sweet clover to emulate it." A table included with the report listed the names of recipients, the amount of seeds given to them, and the amount of land each of them cultivated with sweet clover (see Table 1).[39]

Cultivating sweet clover prior to crops increased soil fertility, prevented erosion, and could serve as fuel, which farmers recognized. In Liguanwan, "self-cultivating farmers" (*zigeng nongmin*) had sown 1 *dan* 2 *dou* (120 liters) of sweet clover seeds over an additional 63 *mu* (4.2 hectares) in autumn 1948, and another 4 *dou* (40 liters) could be planted on an estimated 10 *mu* (.6667 hectares) of land. The Experiment Area also deputed the Tianshui Agricultural Extension Office (Tianshui nongye tuiguangsuo) to distribute 1 *dan* (100 liters) of seeds to plant on 50 *mu* (3.333 hectares) of land and asked the Longxi Farmers Bank (Longxi nongmin yinhang) "to give specially invited farm households [*teyue nongjia*] 2 *dou* [20 liters] to plant on 10 *mu* [.6667 hectares]." Each household planted approximately 143 *mu* (9.533 hectares), which "made a fine start for extension."[40]

As another report from 1948 related, "This Experiment Area's former director Ye Peizhong spared no effort in breeding soil-conserving plants, so after several years of research and experiments, they yielded results and attracted the attention of self-cultivating farmers with many coming to the [Experiment] Area to ask for them." Among these forage grasses, sweet clover was the most popular due to its ability to

[37]Nonglinbu shuitu baochi shiyanqu sanshiliu nian qiyuefen gongzuo yuebao biao [Ministry of Agriculture and Forestry Water and Soil Conservation Experiment Area July 1947 Monthly Work Report Table] (August 1947), Nonglinbu Tianshui shuitu baochi shiyanqu dang'an, file no. 27-2-39. For another copy of the document, see Tianshui shuitu baochi shiyanqu dang'an, file no. 20-59-014-04.
[38]Mo Shiao, "Caomuxi shihua," 102.
[39]Nonglinbu shuitu baochi shiyanqu sanshiliu nian qiyuefen gongzuo yuebao biao (August 1947), Nonglinbu Tianshui shuitu baochi shiyanqu dang'an, file no. 27-2-39. See also Mo Shiao, "Caomuxi shihua," 102.
[40]Nonglinbu shuitu baochi shiyanqu sanshiqi nian jiu yuefen gongzuo jianbao biao [Ministry of Agriculture and Forestry Water and Soil Conservation Experiment Area September 1948 Brief Work Report Table] (October 1948), Tianshui shuitu baochi shiyanqu dang'an, file no. 20-59-015-04. On planting demonstrations conducted by the Tianshui Agricultural Extension Office and the Longxi Farmers Bank, see also Mo Shiao, "Caomuxi shihua," 102.

"increase soil fertility and decrease erosion, while also providing fuel and serving as a preparatory crop for other agricultural crops that yields great results in terms of increasing production."[41]

In addition to these benefits, sweet clover took on enormous economic value as a commodity for Tianshui's rural populace. In the late 1940s, villagers would exchange one *sheng* (one liter) of grain for one *jin* (500 grams) of white sweet clover, which they used as fuel, fodder, and fertilizer. As Yan Wenguang recalled, "The masses had a deep fondness for it and called it 'foreign alfalfa' [*yang muxu*] and 'treasure grass' [*baobei cao*]."[42] During the late 1940s, rural residents carried sweet clover stalks on their backs and went into the city to sell them. Due to the high combustibility of sweet clover stalks, they fetched a price two or three times higher than other kindling. By 1949, farmers had planted more than ten thousand *mu* [666.7 hectares] of sweet clover on the outskirts of Tianshui.[43]

After 1949, cultivation of sweet clover continued to spread. In the 1950s, sweet clover was planted throughout Gansu, eventually extending to over one million *mu* (66,667 hectares) of land in the province. At the behest of the central government of the People's Republic of China, Gansu also sent 500,000 kilograms of sweet clover seed to twenty other provinces for cultivation.[44] By the 1970s, according to one estimate, sweet clover was growing on as many as ten million *mu* (666,667 hectares) of land across China.[45]

The king of trees

The Tianshui Water and Soil Conservation Experiment Area's research on "vanguard tree species" (*xianfeng shuzhong*) during the 1940s and plans to encourage farmers to plant them on abandoned slopes and gullies proved equally successful.[46] Under Ye Peizhong's leadership, the Experiment Area planted over three hundred thousand trees, representing over 20 different species, at its Daliushugou and Longwanggou demonstration sites. Landslides frequently took place in the branch gullies that had formed due to erosion at those two sites, which made them the main source of sediment in the area's watersheds. The Experiment Area focused its research on "biological management" (*shengwu zhili*) techniques to limit erosion in these areas. Black locust (*cihuai, Robinia pseudoacacia*), another foreign tree species, proved most valuable.[47] Black locust trees originated in the southern and central Appalachian Mountains of the eastern United States, but came to China in 1898 as part of afforestation projects in the German concession of Qingdao in Shandong. In the 1920s and 1930s, officials and

[41]Nonglinbu shuitu baochi shiyanqu sanshiqi niandu zhengji bijiao biao (January 1949), Nonglinbu Tianshui shuitu baochi shiyanqu dang'an, file no. 27-2-49. See also Nonglinbu shuitu baochi shiyanqu sanshiqi nian jiu yuefen gongzuo jianbao biao, (October 1948), Tianshui shuitu baochi shiyanqu dang'an, file no. 20-59-015-04.

[42]Yan Wenguang, "Minguo shiqi shuitu baochi zhi zui," 72–73. Other sources state that one *sheng* of grain could be traded for one *sheng* of sweet clover. Mo Shiao, "Caomuxi shihua," 102.

[43]Mo Shiao, "Caomuxi shihua," 102.

[44]Dong Xianghua, "Jiefang qian de Tianshui shuitu baochi gongzuo," 119–120; Gao Jishan, "Zhongguo shuitu baochi shihua (caogao)," 64. See also Mo Shiao, "Caomuxi shihua," 102–103.

[45]Mo Shiao, "Woguo caomuxi de yinzhong tuiguang jingguo," 67.

[46]Nonglinbu shuitu baochi shiyanqu sanshisan niandu zhengji bijiao biao" [Ministry of Agriculture and Forestry Water and Soil Conservation Experiment Area 1944 Achievement Comparison Table] (January 1944), Nonglinbu shuitu baochi shiyanqu dang'an, file no. 27-2-44.

[47]Yan Wenguang, "Minguo shiqi shuitu baochi zhi zui," 72.

rural residents first started planting black locusts in Tianshui and other urban areas in Gansu, where they were known as "German locusts" (*Deguo huai*).[48]

But the initial planting of black locust trees in Northwest China did not have anything to do with conservation. As Yan Wenguang recalled, "Previously in the northwest black locust was mostly a tree species that grew scattered in cities and rarely grew on dry abandoned gullies."[49] Beginning in 1944, Ren Chengtong and Ye Peizhong selected black locust seeds and raised saplings, and in the following year the first trees were planted for conservation purposes in Daliushugou.[50] Preliminary studies showed that black locust trees formed dense, contiguous stands on collapsed slopes, stabilized gullies, and decreased the intensity of mudslides. Experiments likewise proved that stands of black locust trees planted on loess hillsides and gullies held up well under rainfall of around five hundred millimeters. For these reasons, Yan recalled, "The masses praised it as 'the king of tree species'" (*wangpai shuzhong*) for its ability to grow quickly, protect soil, and provide fuel and small-diameter building materials.[51]

While the Experiment Area's personnel considered provision of fuel a "secondary goal" of afforestation, access to kindling from locust trees held real significance for Tianshui's fuel-starved populace.[52] Archival documents are replete with complaints about farmers in villages near the experiment station cutting down immature trees for fuel. To cite but one example, a 1947 report complained that it was not easy to foster "the concept of loving forests" (*ailin guannian*) among local people. Nearby farmers had been urged to preserve trees, but it was hard to keep herders and woodcutters from damaging them. As the report stated, "The northwest's fuel supplies are extraordinarily scarce, and in addition herders cannot store a lot of winter fodder, so protection and management are quite difficult." In gullies near Shimaping village, small trees suffered severe damage, but near Daliushugou "due to propaganda [*xuanchuan*] over the past few years" damage far was lighter.[53] It took persist exhortations and careful monitoring to convince villagers that black locust trees could check gully erosion and should not be cut down.[54]

After 1949, black locust trees spread from Tianshui to other parts of eastern Gansu and neighboring provinces, eventually becoming the main tree variety planted for water

[48]Wan Huiyu, "Jiefang qian de Tianshui linye," 88; Tianshui shuitu baochi kexue shiyanzhan, "Tianshui diqu de yanghuai gougu zaolin," 93; Jiang Shikui, "Yanghuai zaipei jingyan ji qi shuitu baochi xiaoyi de ceyan," 181; and Jiang Shikui and Zhang Bingzhong, "Weihe shangyou yanghuai shuitu baochilin yanjiu baogao," 124.

[49]Yan Wenguang, "Minguo shiqi shuitu baochi zhi zui," 72. See also Wan Huiyu, "Jiefang qian de Tianshui linye," 88.

[50]Tianshui shi kexue jishu zhi bianjibu, *Tianshui shi kexue jishu zhi*, 606.

[51]Yan Wenguang, "Minguo shiqi shuitu baochi zhi zui," 73. See also Gao Jishan, "Zhongguo shuitu baochi shihua (caogao)," 64.

[52]Nonglinbu shuitu baochi shiyanqu sanshiqi niandu shangbannian gongzuo jindu jiantao baogao biao, (July 1948), Nonglinbu Tianshui shuitu baochi shiyanqu dang'an, file no. 27-2-46.

[53]Nonglinbu shuitu baochi shiyanqu sanshiliu niandu yuan yuefen gongzuo jianbao biao [Ministry of Agriculture and Forestry Water and Soil Conservation Experiment Area January 1947 Brief Work Report] (February 1947), Nonglinbu shuitu baochi shiyanqu dang'an, file no. 27-2-25. This document is also available in Tianshui shuitu baochi shiyanqu dang'an, file no. 20-59-014-04.

[54]Nonglinbu shuitu baochi shiyanqu sanshisi niandu zhengji bijiao biao [Ministry of Agriculture and Forestry Water and Soil Conservation Experiment Area 1945 Achievement Comparison Table] (January 1946), Nonglinbu shuitu baochi shiyanqu dang'an, file no. 27-2-44. This document is also found in Tianshui shuitu baochi shiyanqu dang'an, file no. 20-59-013-07. Nonglinbu shuitu baochi shiyanqu sanshiliu nian er yuefen gongzuo jianbao biao [Ministry of Agriculture and Forestry Water and Soil Conservation Experiment Area February 1947 Brief Work Report] (March 1947), Nonglinbu shuitu baochi shiyanqu dang'an, file no. 27-2-25; and Nonglinbu shuitu baochi shiyanqu sanshiliu nian san yuefen gongzuo jianbao biao [Ministry of Agriculture and Forestry Water and Soil Conservation Experiment Area March 1947 Brief Work Report] (April 1947), Nonglinbu shuitu baochi shiyanqu dang'an, file no. 27-2-25. The last two documents cited are also in Tianshui shuitu baochi shiyanqu dang'an, file no. 20-59-014-04.

and soil conservation purposes in the upper reaches of the Wei River and elsewhere.[55] Between 1950 and 2005, China's state-led afforestation programs planted black locust on over 70,000 hectares of land throughout the Loess Plateau region.[56]

Nonhuman invaders

Sweet clover and black locust trees had two qualities that made them highly attractive to water and soil conservation experts as well as Tianshui's rural populace. Both plants grew quickly, which brought rapid results in revegetating barren slopes. They also had the ability to fix atmospheric nitrogen, which improved soil fertility and crop production. The priority that China's wartime state placed on increasing agricultural production and the resource shortages that plagued Northwest China's rural populace make their shared embrace of sweet clover and black locust trees understandable. But from a longer-term perspective, the diffusion of these plant species did not have unambiguously positive ecological effects.

Since the beginning of their large-scale extension in the mid-1940s, white sweet clover and yellow sweet clover have been established in 22 of China's provinces and municipalities. Their diverse habitats include fallow fields, grasslands, tree nurseries, and along railways and roads, especially in areas with a history of ecological disturbance. In the farmland-grassland ecotones of northern China, sweet clover exerts a disruptive influence. As an invasive species in prairies and steppes, sweet clover degrades grasslands by overtopping and shading native plants that thrive on sunlight. In this manner, sweet clover alters the composition and structure of local vegetation in ways that negatively impact biodiversity and grassland utilization.[57] A miracle plant became a menace once it spread from farmland to grassland. But historical actors in wartime Gansu never could have anticipated these consequences, and it would be foolish to expect otherwise. From their perspective, sweet clover's ability to check erosion, increase soil fertility, and ameliorate critical fuel shortages made this foreign plant variety a treasure grass rather than an ecological invader.

Black locust trees, once heralded as the king of tree species for conservation purposes, caused greater problems. Until several years after reaching maturity, black locust trees enrich soil nutrients, including nitrogen, and improve soil fertility. Yet high levels of water consumption by this thirsty tree species often leads to the formation of a dry soil layer that becomes an ecological hazard for other organisms and hampers replenishment of the water table. Because soil water availability is a major factor limiting vegetation growth in China's Loess Plateau region, large-scale black locust plantations aggravate water shortages and increase the risk of desertification. Furthermore, current research questions the role of black locust trees in protecting against erosion. Rather than limiting soil loss, black locust plantations decrease functional diversity by reducing the perennial herbaceous species that do the most to resist erosion. Black locust trees thus have "negative implications for water recharge" in deeper soils and little benefit in protecting against soil erosion because of "their negative effects on perennial herbaceous species."[58]

[55]Gao Jishan, "Zhongguo shuitu baochi shihua (caogao)," 64; and Wan Huiyu, "Jiefang qian de Tianshui linye," 88.
[56]Kou et al., "The Effect of *Robinia pseudoacacia* Afforestation," 147.
[57]Chen et al., "Invasion of Farmland-Grassland Ecosystems," 1012–1016.
[58]Kou et al., "The Effect of *Robinia pseudoacacia* Afforestation," 146–158 (quotation from p. 157). See also Jiang et al., "Negative Impacts of Afforestation."

When planted on a large scale, a tree that once seemed an indispensable ally in the war against erosion turned out to be a liability. A desire for rapid results forged in the crucible of wartime urgency and resource scarcity invited unintended ecological consequences.

Conclusion

World War II accelerated and amplified multiple forms of mobility, including the circulation of environmental ideas and activities.[59] During that period, in dialogue with American advisors like Walter C. Lowdermilk, the Chinese Nationalist regime adopted and promoted globally circulating environmental ideas and techniques to further the wartime agenda of developing the northwest and its resources. It also bears noting that the Japanese invasion forced many of the experts employed at the Tianshui Water and Soil Conservation Experiment Area to migrate there and to implement these programs. One example was Ye Peizhong, who migrated from Southeast China to the northwest. But for these mobile scientific and technical elites to have any chance of carrying out the globally circulating ideas about conservation that they championed, their plans had to resonate with the environmental and socioeconomic realties of rural Northwest China. Embankments, sweet clover, and black locust trees could not turn into treasures until they found a place in the fabric of local society.

For Chinese water and soil conservation specialists in Tianshui during the 1940s, resisting the Japanese and reconstructing the Chinese nation meant limiting water and soil loss by rationalizing land use. Tianshui's rural populace did not subscribe to this view. In the eyes of local farmers, the available evidence indicates, water and soil conservation held value only when it could improve their livelihoods. Farmers showed little enthusiasm for experimental terraces and ditches that cost more than they could afford to invest, inadvertently decreased soil fertility and submerged grain seedlings, fragmented their landholdings, and made cultivation more difficult. Because of these problems, the rural population often harbored suspicion or even hostility towards these conservation projects. It took a simpler and more cost-effective method of terrace and ditch design – embankments – for their construction to gain support from local farmers.

By contrast, rural people readily took to the new tree and grass varieties introduced by the Tianshui Water and Soil Conservation Experiment Area; cultivation of these new introductions spread across Gansu's landscape and transformed its vegetation cover. During the wartime period, sweet clover and black locust trees advanced the Experiment Area's desire to check erosion and boost agricultural production, without burdening farmers with the kind of labor inputs and investments required to build terraces. Tianshui's rural residents especially welcomed sweet clover and black locust trees because their introduction alleviated critical fuel shortages that Northwest China's wartime population influx had only aggravated. Yet even if sweet clover and black locust trees met critical needs during the 1940s, the transmission of these invasive plant species eventually brought deleterious ecological effects.

[59]See, for example, Brazelton, "Danger in the Air"; Shen, *Unearthing the Nation*, chapter 5; and Kinzley, *Natural Resources and the New Frontier*, chapters 5–6.

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Glossary

ailin guannian	爱林观念
baihua caomuxi	白花草木樨
baobei cao	宝贝草
baochi tudi yongjiu shengchan nengli zhi yuanze	保持土地永久生产能力之原则
baoxu	保蓄
caodai	草带
caomuxi	草木樨
chaihuang	柴荒
chonghua	重画
cihuai	刺槐
Daliushugou	大柳树沟
dibian geng	地边埂
di jin qi li zhi fangfa	地尽其利之方法
Chongqing	重庆
Chongqing tongyou yanjiusuo	重庆桐油研究所
Deguo huai	德国槐
Emeishan linye shiyanchang	峨眉山林业试验场
Gansu	甘肃
gaijin tudi	改进土地
Guangxi	广西
Guoli Xibei jishu zhuanke xuexiao	国立西北技术专科学校
huailü	怀虑
Huanghe shuili weiyuanhui	黄河水利委员会
Huanghe shuitu baochi Tianshui zhili jiandu ju	黄河水土保持天水治理监督局
huanghua caomuxi	黄花草木樨
Huangtu gaoyuan	黄土高原
huaxia minzu de faxiangdi	华夏民族的发祥地
Hunan	湖南
jianshe Xibei	建设西北
Jiangyin	江阴
kaifa bianjiang	开发边疆
Liangjiaping	梁家坪
Liguanwan	李官湾
Liucheng linchang	柳城林场
Liuzhou kenhuangju	柳州垦荒局
Longnan shuitu baochi shiyanqu	陇南水土保持实验区
Longwanggou	龙王沟

Longxi nongmin yinhang	陇西农民银行
Lüergou	吕二沟
Ma Xiaolin	马效林
Ma Zhanbiao	马占彪
Mi Jihou	米积厚
mucao yuanzhongchang	牧草原种场
Mu Dezi	穆德子
Nanjing	南京
Nonglinbu	农林部
Nongminjie dahui	农民节大会
Qingdao	青岛
Qinghai	青海
Ren Chengtong	任承统
Shaanxi	陕西
shengtu	生土
shengwu zhili	生物治理
shengzhi nengli	生殖能力
Shimaping	石马坪
shitu	失土
shouyi	受益
shuitu baochi	水土保持
Shandong	山东
Sichuan	四川
teyue nongjia	特约农家
Tianjiazhuang	田家庄
Tianshui	天水
Tianshui nongye tuiguangsuo	天水农业推广所
Tianshui san da bao	天水三大宝
Tianshui shuitu baochi kexue shiyanzhan	天水水土保持科学试验站
Tianshui shuitu baochi shiyanqu	天水水土保持实验区
titian gouxu	梯田沟洫
wangpai shuzhong	王牌树种
Wei Zhanggen	魏章根
xianfeng shuzhong	先锋树种
Xibei kaochatuan	西北考察团
Xibei nongxueyuan	西北农学院
xuanchuan	宣传
Yan Wenguang	闫文广
yang muxu	洋苜蓿
Yang Shirong	杨世荣
Ye Peizhong	叶培忠
yu si	淤死
zigeng nongmin	自耕农民
Zongli lingyuan	总理陵园

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